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Transition Plan for Moving AFOMS Occupational Analysis Report Contents to AFPC's Human Resources Research Database

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The Air Force Personnel Center's Force Management Liaison Office (AFPC/DPSF) is frequently called upon to respond to human capital management issues that periodically arise among stakeholders of the Air Force. DPSF directly supports the Force Management Division (HQ AF/A1PF) of the Air Staff's Manpower and Personnel Directorate. In order to support AF/A1PF in a timely manner, DSPF maintains a Human Resources Research Databank (HRRD), a repository of data that enables a wide range of research questions to be addressed relatively quickly. The Air Force Occupational Analysis Program of the Air Force Occupational Measurement Squadron (AFOMS) is one valuable source of information for the HRRD, and in 2007, DPSF stated a requirement for a plan to facilitate the systematic flow of completed Occupational Analysis Reports (OAR) from AFOMS to the HRRD.

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Executive Summary

Introduction. The Air Force Personnel Center's Force Management Liaison Office (AFPC/DPSF) is frequently called upon to respond to human capital management issues that periodically arise among stakeholders of the Air Force. DPSF directly supports the Force Management Division (HQ AF/A1PF) of the Air Staff's Manpower and Personnel Directorate. In order to support AF/A1PF in a timely manner, DSYX maintains a Human Resources Research Databank (HRRD), a repository of data that enables a wide range of research questions to be addressed relatively quickly. The Air Force Occupational Analysis Program of the Air Force Occupational Measurement Squadron (AFOMS) is one valuable source of information for the HRRD, and in 2007, DPSF stated a requirement for a plan to facilitate the systematic flow of completed Occupational Analysis Reports (OAR) from AFOMS to the HRRD.

Methodology. The approach for developing the Transition Plan was three-phased. In the first phase, the current AFOMS processes for gathering data and developing an OAR were examined. AFOMS uses survey methods to gather task performance data from Air Force job incumbents and task factor rating data from experienced subject matter experts. A variety of analytic tools are then applied to interpret the implications of the data for issues such as currency of training standards, classification decisions, personnel utilization policies, and other Air Force personnel programs. In the second phase of this project, the tools expected to be useful to the HRRD were examined to identify data requirements which can be satisfied by AFOMS's methods. In the final phase, an analysis was conducted to identify gaps between data available from the OAR process and those data needed by the HRRD tools. The third phase closes with recommendations on how to resolve gaps between available and needed data.

Phase I. The process for developing and conducting occupational surveys have remained relatively stable for many years, although the methodology has regularly been automated and streamlined as new tools and techniques emerged. The most substantial recent change has been a shift in how the data are handled after collection is completed. Data are now converted into relational tables within the ORACLE database system as opposed to the previous hierarchical OA study approach, with ASCII files containing individual records for each respondent within a given study. Despite the shift to a relational database format, data elements remain in place to perform basic analyses as before; and it should be possible to reassemble the database output for a given project in a form resembling the output of the previous approach. AFOMS has changed analysis software, moving from the Air Force-developed legacy Comprehensive Occupational Data Analysis Programs (CODAP) to the commercially available Statistical Package for the Social Sciences (SPSS); the newer software is reported to address the same data-analytic functions as did the legacy software, however, if head-to-head comparisons have been made to demonstrate exact equivalence of the outputs, this author has not seen the comparisons published or reported. Some analytic procedures are no longer being performed, such as the hierarchical clustering by task. Other procedures, such as hierarchical clustering by case, are being performed on limited numbers of reports. The format of the OAR has substantially changed, moving from a Microsoft Word™ report format to an EXCEL™ report style with tables and graphics embedded in a report which thoroughly presents analyses in ways that address current users' issues; however, most of the critical analytic views within the OAR remain from legacy reports. Interestingly, current reports address emerging issues, such as differential analyses of deployed versus home station work responsibilities and distinctions among

active duty, Air National Guard and Air Force Reserve incumbents, reflecting a responsible approach to performing occupational analysis within a dynamically changing Air Force.

Phase II. AFPC/DPSF identified a number of tools for addressing questions which arise as force management and operational tempo issues intersect. They recognize the potential for developing new tools should requirements arise, to provide timely yet responsible data-grounded analyses and recommendations to those recurring questions. Key among those tools are:

- Training Impacts Decision System (TIDES),
- Training Efficiency and Effectiveness Methodology (TEEM),
- Simulation Utility Analysis System (SUMS),
- Acquisition Information Retrieval and Simulation (ACQUIRES), and
- Job Structuring Technology (JST).

In addition, the Benchmarked Occupational Learning Difficulty (BOLD) technique, developed jointly by the Air Force Research Lab and AFOMS, has potential for supporting cross-occupation analyses not generally supported by AFOMS'S routine analytic practices. The data requirements documents for these tools were examined to determine which of the required data elements could be supplied by the current AFOMS products and relational database.

Phase III. In analyzing the gap between current AFOMS/OA outputs and those requirements of the HRRD tools, most of the needed data are available; however, some data types have been discontinued or modified. Task factor data were routinely collected on all tasks within a given survey project; but in an effort to be responsive to their primary customers, AFOMS/OA modified the strategy for collecting Task Learning Difficulty in most surveys, restricting data collection primarily to technical tasks, omitting the supervisory, planning and evaluating, and some administrative tasks. Further, while the ratings are presented, there is scant evidence the data have been evaluated for inter-rater reliability prior to publishing. The TEEM tool is somewhat impacted by the reduction in availability of some Task Learning Difficulty data; however, the impact is not insurmountable. One tool, TIDES, was founded on two principle sources of occupational analysis data; the task module and job structure. By replacing hierarchical case clustering in some studies with the practice of trusting job incumbents to select their job title from a list of expected titles, the question of validity of the job structure arises. Reduced validity of the job structure can impact the effectiveness of TIDES. Task clustering forms task modules, the building blocks of jobs within TIDES. Therefore, the elimination of task clustering risks TIDES becoming less effective in modeling the utilization patterns and training requirements for Air Force occupations. Questions about validity of job structures also risk impacting other tools, such as SUMS, ACQUIREs, and JST. Addressing these data shortfalls will not be a simple matter; however, it would be worthwhile for DPSF to have the ability to resurvey occupations to gather supplemental data in a timely fashion not captured by AFOMS'Ss primary surveys. Given the available AFOMS/OA products, that should be feasible on a project by project basis from within the HRRD.

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Transition Plan for Moving AFOMS Occupational Analysis Report Contents

to

AFPC's Human Resources Research Databank

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INTRODUCTION

As Air Force organizational structures have changed over the years, responsibility for answering human resource policy issues has more clearly rested with Headquarters Air Force, Directorate of Manpower and Personnel (HQ AF/A1). As the Field Operating Agency of AF/A1, the Force Management Liaison Office (DPSF) of the Air Force Personnel Center (AFPC) (see 12 FTW, 2008) is tasked with developing and sustaining a data repository to support AF/A1 in addressing the short-notice human resources policy issues. That repository, the Human Resources Research Databank (HRRD), consists of collections of research and operational data sources that enable AFPC/DPSF and AF/A1 to respond in a timely fashion to inquiries regarding the likely effects of various policy options facing Air Force stakeholders. This Databank houses both current and historical data for use in addressing both longitudinal and cross-specialty questions relating to personnel recruiting, selection, training, employment, and promotion (Christal, 1974). The data are expected to be useful in developing screening criteria for selecting new accessions, making effective personnel classification and assignment determinations, and designing Promotion Fitness Exams (PFEs) and Specialty Knowledge Tests (SKTs) to support the Weighted Airman Promotion Testing System (WAPS). It may also enable answers to questions of the viability of options for AFS restructuring initiatives, the utility of job performance measures in managing the force, and application of personality variables in ensuring effective and efficient use of human capital in assignments (person-job-match). Some of the tools at the HRRD's disposal include the Training Impacts Decision System (TIDES), Training Effectiveness and Efficiency Methodology (TEEM), Simulation Utility Analysis System (SUMS), Acquisition Information Retrieval and Simulation (ACQUIRES), and Job Structuring Technology (JST), as well as the selection instruments such as the Armed Forces Vocational Aptitude Test Battery (ASVAB) and the Air Force Officer Qualifying Test (AFOQT).

The Air Force Occupational Analysis Program of the Air Force Occupational Measurement Squadron (AFOMS) is one of several valuable sources of information for the HRRD. DPSF has a requirement for a plan to facilitate the systematic flow of completed Occupational Analysis Reports (OAR) from AFOMS to the HRRD. This report presents that plan.

METHODOLOGY

The approach for developing this Transition Plan was discussed at a contract kick-off meeting held November 29th, 2007 at HQ Air Force Recruiting Service, Randolph AFB TX. The initial intent was to have the plan developed in three-phases. In the first phase, the current AFOMS processes for gathering data and developing an OAR were to be examined, with attention paid to the processes used to gather data from Air Force job incumbents and subject matter experts and to convert that data into formats needed for currently used analytic tools and reporting practices. Information gathering was to be performed by interviewing key AFOMS staff members, especially those responsible for constructing occupational surveys, those responsible for converting the surveys into automated form for online data collection, those responsible for converting the resultant raw data into data files suitable for the analysis software, and those responsible for analyzing results, preparing finished products, and working with customers to apply the analysis results to ongoing Air Force applications.

In the second phase, the tools expected to be useful to the HRRD were to be examined to identify data requirements which can be satisfied by AFOMS' methods. Conversations with AFPC/DPSF, HQ AF/A1, and other interested stakeholders suggested a modest number of tools that should be considered. The plan was to examine published research and extant documentation for the specified tools to identify key data requirements that may be available through AFOMS' products.

In the final phase, an analysis was conducted to identify gaps between data available from the OAR process and data needed by the HRRD tools. The third phase was expected to close with recommendations on how to resolve gaps between available and needed data.

It was necessary to modify this methodology several times during the course of the project, due to unanticipated limitations in availability of AFOMS personnel. At the time the project kicked off, there was an announcement that the Air Force Management Agency (AFMA) was initiating a possible A-76 Study which would evaluate the work being done by AFOMS to determine if it is inherently governmental and if not, consider whether it should be outsourced (OMB, 20003). Due to the sensitivity of the study, requests for needed interviews were postponed, and then later, declined as the decision process worked its way through stakeholder coordination channels. In March 2008, permission was received to conduct some interviews. Two were accomplished, with staff members of the Occupational Analysis Section (AFOMS/OAO) and the Inventory Development Section (AFOMS/OAV). One further interview was scheduled, (with a representative of the Resource Management section (AFOMS/RM); however, that interview was canceled after (1) the AFOMS senior staff briefed AFPC/DPSF and AF/A1 personnel on current methodology, and (2) this author had a telephone dialogue with the RM chief who answered many of the outstanding questions. The information gathering for Phase I was further complicated by a number of staff changes at AFOMS in early 2008, resulting in uncertainties about the future direction of AFOMS. That future direction was finally resolved when the decision was reached that the A-76 Study would not be conducted, but 30+ military positions within AFOMS would be reallocated to the Air Force and the smaller-sized Occupational Measurement Squadron would be staffed completely by civil service personnel.

RESULTS

Phase I. Rumors of dramatic change in the OAR process are somewhat overstated. The process for developing and conducting occupational surveys (Christal, 1974) has remained relatively stable since the program was founded, although many mundane and tedious aspects have been automated and streamlined, and presentation of the survey instrument has been realigned to focus first on the more technical aspects of each occupation's work as opposed to starting with leadership, supervisory, training, and administrative tasks.

Conceptually, data processing is currently handled in a different way than it was in earlier years of the program. Raw survey data are now converted into relational tables within the ORACLE database system as opposed to the previous hierarchical OA study approach, with ASCII files containing individual records for each respondent within a given study. Despite the shift to a relational database format, data elements remain in place to perform basic analyses as before; and it should be possible to reassemble the database output in a form resembling the form in which the data were collected.

AFOMS has changed analysis software, moving from the legacy Comprehensive Occupational Data Analysis Programs (CODAP), a suite of tools developed by the Air Force Research Laboratory (Christal, 1974, and Christal & Weissmuller, 1988) to the commercially available Statistical Package for the Social Sciences (SPSS). The newer software is advertised to address the same data-analytic functions as did the legacy software, but has the advantage of being more intuitive and having a more user-friendly graphic interface; however, if head-to-head comparisons have been made to demonstrate exact equivalence of the outputs, this author has not seen the comparisons published or reported. Some analytic procedures are not being performed any more, such as the hierarchical clustering by task, while other procedures, such as hierarchical clustering by case, are being performed on limited numbers of reports.

The format of the OAR has substantially changed, moving from a Microsoft Word™ report format to an EXCEL™ report style with tables and graphics embedded in a report which thoroughly presents analyses in ways that address current users' issues; however, most of the critical analytic views within the OAR remain from legacy reports, such as specialty job structures, analysis of skill level differences, training analysis (to include first job tasks, first enlistment tasks, comparison to specialty training standards, and task factor analyses), differential analysis of major command (MAJCOM) requirements, and job satisfaction/retention analyses. Interestingly, current reports address emerging issues, such as differential analyses of deployed versus home station work responsibilities and differential analyses of distinctions among active duty, Air National Guard and Air Force Reserve incumbents, reflecting a responsible approach to performing occupational analysis within a dynamically changing Air Force.

The following paragraphs describe conversations held with AFOMS personnel during the month of April. They are not in chronological order. The first two conversations, discussing the OA process are presented first, followed by results of a telephone conversation on how data are processed in the current approach.

Discussion with AFOMS/OAV:

The author met with three staff members of the combined Inventory Development and Data Collection section, AFOMS/OAV, April 30th (McDaniel, Ostrander, & Cluxton, 2008) and received excellent cooperation and patience. We discussed front-end procedures of the OA process. One interviewee headed the section constructing job inventories. Another interviewee was long-time technical expert in automating surveys for field administration, and the third interviewee had been selected to assume the role of automating surveys for administration. We discussed their process from initiating new surveys to retrieving recently archived inventories, validating and updating previous iterations of the job inventories, readying new job inventories for administration, soliciting and managing data collection, performing quality assurance of incoming data, and submitting the resulting data files to AFOMS/RM for further processing.

In current procedures, when a survey is completed, the raw data file, an ACCESS file (*.mdb) is cleaned to remove grossly flawed cases (e.g., respondents who began a survey in error and realized the survey was not for their Air Force Specialty [AFS], or respondents who quit the survey early and gave an obviously incomplete record). Output from that process, is analogous to our old raw "input standard" file. Under current policy, a copy of the cleaned data file is retained by AFOMS/OAV and a copy is submitted to AFOMS/RM for entry into ORACLE. During the change-over from using CODAP for analysis to using SPSS, there was a gap of approximately two years, when cleaned files were not retained. As a result, only the RM section will have historical versions of the "input standard analog" files during that period.

Discussion with AFOMS/OAO:

The author met with two staff members of AFOMS/OAO April 16th (Dubois and Luster, 2008) and received excellent cooperation and patience. They explained the current AFOMS/OA organizational structure and described the current process used in conducting occupational analysis. The program continues to follow historical precedents for the OA process as it has been practiced for over 25 years (Christal, 1974), but has integrated new technical features to accelerate and streamline processes. Despite plans to reengineer the program, there are still designated sections of staff devoted to developing job inventories, collecting the survey data, and performing analysis, preparing reports and delivering results to the training community at Utilization and Training Workshops. This organizational structure seems to satisfy both the volume and quality concerns as the program strives to satisfy key customers' needs. The definition of "customer" has evolved somewhat over the years, as the Air Force adjusted to technology changes, evolving mission requirements and budgetary realities. Today, the OA Program views their primary customer as the training community. While that community has always been a major consumer of OA, other customers, such as the recruiting, personnel classification, and promotion testing communities seem to have become of less pressing importance.

The OA program converted their reports from Microsoft Word™ format into an EXCEL Workbook™ format which retains and integrates much of the narrative from former reports with the many tables of data viewing survey results from a variety of viewpoints. One key analytic procedure, the *job structure analysis* procedure changed substantially over the past half-dozen years. For many projects, the formal job typing techniques are no longer used, but have been replaced with a strategy of depending on job incumbents to sort themselves by selecting their job title from a list provided in the Biographical/Background section of job inventories. While this strategy has some appeal, it is fraught with risks. Depending on the descriptive quality of job titles, the complexity of the specialty, and the

degree of specialization within, incumbent-defined job-type groupings contain a great deal of variance and do not capture the nuances of job-type groupings derived from the job clustering approach. For instance, it is possible for incumbents to inflate the importance of their jobs by selecting a title that should require special training, experience or other qualifications. In some AFSs, technological standardization has driven incumbents into very homogeneous work patterns, and most members respond not to descriptive job titles, but to the official title of the specialty to which they belong (e.g., "I'm a Pavements and Construction Equipment Specialist, not a Horizontal Heavy Equipment Operator or a Tool Crib Manager"…). However, there are still some projects where the formal Job Typing methodology is still in use, applying the hierarchical case clustering methodology originally endorsed by Christal (1974) as a way of revealing the natural organization of work into "jobs" and groups of jobs. A question remains, however, as to whether the results of Job Typing using the SPSS analysis package is equivalent to that provided by the legacy system, since to this author's knowledge, no head-to-head comparisons have been reported. SPSS contains at least two types of hierarchical clustering, the Ward Method and the D^2 Minimizing Sum of Squares. The former was the method used in prior years analysis and was adopted because it presents a more accurate picture of occupations when large numbers of variables (e.g., tasks) are involved, since it forces membership, at each level, into one group or another. The latter method, sometimes called the Q-factor hybrid method, allows for membership in multiple groups, and thus, produces a less-clearly defined job structure (Levine, 2003).

The OA interviewees described the data flow from the time a survey project data set arrives in their section through their clean-up and analysis processes. They indicated that AFOMS' RM section now centrally processes the data collected and imports it into the ORACLE database. The output is subsequently formatted for analysts in a product called PREPE, akin to the refined "Input Standard" file, and representing the original data set with the most extreme unqualified cases eliminated. Analysts use the PREPE data (which pulls data from another program called CAROMS, the mailing list generator) to ensure remaining cases fit the criteria for inclusion in the analysis (member is available for duty, has correct AFS, has at least 6 months on the job, is not imminently changing permanent stations nor retiring during the planned survey administration period). From there, the data is input into SPSS for some analyses, and then transferred to EXCEL for creation of standard and custom tables.

The interviewees provided examples of several projects, showing the new layout, including one study where the traditional job-typing analysis was being conducted. Although the formats are new and fresh, the essential structure remains. In one report, the new format follows the traditional research layout of providing an executive overview, describing the methodology used, describing the survey sample, with emphasis on demonstrating its representativeness of the population being studied, and moves into a results phase, where various analyses are discussed in a rational order. Included within the analyses are the key sections of interest to the training community (analysis of initial first job and first enlistment training requirements, evaluation of support for Specialty Training Standards). There was some description of the process used to gather task factor (task learning difficulty and training emphasis) ratings, but this author didn't see any information describing the sampling data and representativeness of the Subject Matter Experts, nor any measure of their degree of agreement in providing task factor data (Mitchell, 1994), although the ratings summary scores were included.

In another example, the task factor methodology was even less clearly presented. The reports conclude with a variety of analyses regarding, differences in employment by major commands, employment at home station verses deployed, total force issues, and job satisfaction and retention analyses.

The interviewees reported that, while the OA program is still willing to perform officer and special management studies, most of their efforts are focused on satisfying requirements for collecting and processing data to address training issues on a 3-year cycle covering the entire spectrum of enlisted specialties. In large measure, this is due to a resource constraint.

We concluded by revisiting discussions of interfaces with other sections; specifically, work done by inventory development and data collection sections and the AFOMS/RM interface. As online surveys are completed by job incumbents, data are stored temporarily in ACCESS databases, then cleaned and imported into the enterprise ORACLE database. The AFOMS/RM staff process those data and make them available to analysts, who work off-line to construct the Occupational Analysis Report (OAR), building tables and illustrations, analyzing nuances within the data, writing narratives to describe method, interpret results, and compose descriptions of findings with the potential interest to users. The OAR is very training-oriented, but could be much broader in impact if potential users framed challenging questions that helped direct analysts' attention beyond the training issues. In absence of regular dialogue on problems other than training, their attention is directed to addressing immediate needs of the training community.

Discussion with AFOMS/RM:

The author made numerous attempts to meet during the month of April with the Chief, AFOMS/RM, but due to leave and TDY schedules on his part, we were unable to arrange a meeting. Several issues were of interest in having the meeting with the AFOMS/RM. From previous interviews, it appeared the survey data collected via MTISurv were being processed into an ACCESS data file and transferred to RM for import into the ORACLE database for analysis. Since each survey layout may be different, it is important to the success of this Transition Plan to know the precise file names, structures and procedures to interpret the unique survey data records in order to catalogue each survey into HRRD. Without this fundamental information, AFPC/DPSF is left having to reverse engineer every step of the analysis process. Also, it is important to the success of this Transition Plan to have both the "raw data file" and the "processed data file from the final report." The needs are evident. The final files should match the results of the OA and provide support and explanation for report contents. The "raw" files, on the other hand, enable extended analysis into issues associated with a given AFS which was not a stated requirement when survey was initiated, but could arise after the OA was completed and archived. In addition, the "raw" file would provide a foundation for meta-analysis across multiple surveys on comparative analysis issues not addressed in the original AFOMS mission.

This author also planned to discuss with the RM Chief the specific SPSS algorithm(s) used to perform cluster-merger analysis in those cases where job typing is done. At issue is that during their reengineering of the OA process, RM have not been very clear that the current algorithm is the same one used in the previous analysis package, and raises questions of equivalency in the final product. If any head-to-head analyses have been performed, this author is unaware of any report or publication showing that equivalency.

The AFOMS/RM and this author did schedule a meeting for May 5th. Unfortunately, the May 5th meeting was rescheduled two times, and then cancelled by a telephone call the morning of May 9th (AFOMS/RM, 2008). In cancelling the meeting, the RM stated that the AFOMS/CC had met the previous day with AFPC/DPSF staff, along with a representative of HQ AF/A1PF, and the head of the AFSO21 team conducting a reengineering review of the OA program. The Commander stated that

AFPC/DPSF will receive "all the data from AFOMS as each survey is completed." The RM Chief stressed that the data are stored by ORACLE in a relational database and that it would be "millions of lines of code" for each survey. As we discussed the future directions for this Transition Plan, the RM Chief suggested that, perhaps, he could forward a sample study to AFPC/DPSF for evaluation.

On May 15th, AFPC/DPSF forwarded some sample data from AFOMS/RM for review and comment. It appeared the ORACLE output of "raw data" was similar to the data used to process the recent Similarity of Skills project; the AFOMS data appeared to have been converted to a series of ACCESS tables for the analysts to work on using their preferred analysis software suite, SPSS. It did not, however, show any resemblance to the "individual record" format that is output from MTISurv. AFPC/DPST was interested in whether the ORACLE output could be worked backward to reassemble the "individual record" format that would be useful for input into TIDES, TEEM, SUMS and other tools envisioned for HRRD. They inquired whether the MTISurv Utilities program could do such reassembly. In its current configuration MTISurv Utilities will not reverse the conversion to ORACLE (Metrica, 2002), but it could be modified, or an alternative program developed, to assemble a new file from the ORACLE output into a format equivalent to one that would have resulted from the MTISurv output, provided key information about structures, variable names, etc., of the original survey instruments are retained. The essential requirements remain: there must be a clear definition of files that went into a given survey at the beginning of analysis. With the raw ORACLE output and a definition of the records that were used to input them, a relatively easy program could be developed to reassemble the outputs into the original records, and formatted in a number of options, including the very basic ASCII "comma-separated variable" layout, and from there, manipulated by a number of analysis tools.

Phase II. AFPC/DPSF and AF/A1 recognize that there are persistent questions which arise as force management practices, budgetary realities, and operational tempo issues intersect. DPSF has identified a number of tools available, and recognizes the potential for developing new tools should the requirements arise, to provide timely yet responsible data-grounded analyses and recommendations to those recurring questions. Many of the tools grew from research in human capital management that was funded, supervised, and in many cases, performed by the Air Force Research Laboratory and its predecessor organizations. Key among those tools are TIDES, TEEM, (SUMS, (ACQUIRES, and JST. In addition, the BOLD technique (Mitchell, Tucker, Fast, Bennett, & Albert, 1997; Mitchell, 1994), developed jointly by the Air Force Research Lab and AFOMS, has potential for supporting cross-occupation analyses not generally supported by AFOMS' usual analytic practices. The data requirements documents for these tools were examined to determine which of the required data elements could be supplied by the current AFOMS products and relational database.

Training Impacts Decision System (TIDES) Requirements:

The TIDES is a technology that extends traditional occupational analysis by creating an entity-based model of the flow of personnel through an Air Force Specialty (AFS). In concept, it captures a snapshot of the entire population (or at least, a representative sampling of members) in various stages of career development. It views an AFS in terms of "career cohorts" that enter at the basic training point, flow together through technical training, and then are assigned to various initial jobs. From the initial jobs, they subsequently move as cohort stages are crossed, from one job to another. At some stages, they pass through professional military education and other specialized and advanced training events. From one

stage of progression to another, the cohorts shrink with observed attrition. TIDES provides cost and capacity estimates based on a number of standardized values, such as per diem, airline rates, and salaries, as well as some nuanced values, such as the length of technical training for different AFSs, probabilities of movement from a lower-level job to higher-level jobs (with attendant training costs), attrition rates at different career stages, and availability of resources for use in training. The resulting patterns of assignment and career progression flow represent an "As-Is" model of the career field. Subsequently, policy changes (such as lengthening "average time on station" or "restructuring particular jobs") are imposed on the "As-Is" to create various "To-Be" scenarios, and differential analysis will reveal the advantages and challenges of making those changes – before budgets, individuals, and missions are impacted. A number of data elements are readily available (e.g., salary rates, pediem rates for various locales, air fare and TDY reimbursement rates). Other data are uniquely generated within the TIDES methodology (Stone, Vasquez-Maury, Fast, and Borden, 2005; Mitchell, et al., 1997; Mitchell and Stone, 1997; Mitchell, Bennett, Wimpee, Grimes, and Stone, 1995; and Chin, Lamb, Bennett and Vaughn, 1992). Those unique data sets include:

A. Job and Training History (J&TH) Survey, capturing personal history of job assignments, formal training courses, and professional military education of a large sample of personnel and AFS;

B. Task Module-to-Jobs Map (TM-Jobs Map), identifying linkages between Job Titles and TMs;

C. Resident Course Training Times Questionnaire (TT), collecting high fidelity information on time dedicated to task modules (TM) within formal training courses broken out by hours dedicated each TM in classroom, laboratory and self-study as well as hours instructors spent preparing to teach each knowledge or performance requirement;

D. Training Resource Requirements Questionnaire (TRR), identifying training resources required for each course, student capacity of each course, and, resource capacities available to each course;

E. Task Module Learning Curves Questionnaire (LC), collecting data on maximum attainable proficiency by an individual using specified training delivery methods (classroom, laboratory, self-study and on-the-job-training, or UQT/OJT), and hours required to attain the "go/no-go" level of proficiency; and

F. Unit Qualification Training/On the Job Training Resource Availability Questionnaire (TRA), estimating capacity of exemplar operational units to conduct UQT/OJT, (specifically, availability of qualified trainers as well as flow of trainees through UQT/OJT).

AFOMS data can significantly support TIDES analysis. There are two key elements associated with the Job Structure analysis that are integral to effective TIDES analyses. First is quality of the job structure itself; TIDES models the jobs that make up the AFS, and links jobs by specifying the probability of progression from any one job to another in the next higher cohort. To construct high-fidelity TIDES models, it is important that the job structure is as close to the real world as possible. The second element is quality of Task Modules (TMs). In TIDES, TMs are viewed as the building blocks of jobs. In contrast, OARs view the tasks themselves as the building blocks of jobs. Thus, to perform TIDES successfully, it is necessary to group tasks according to some taxonomy that works to reduce the number of building blocks involved to a manageable level. One method that has been used is the co-performance clustering technique, which hierarchically groups tasks with other tasks that have a high probability of being

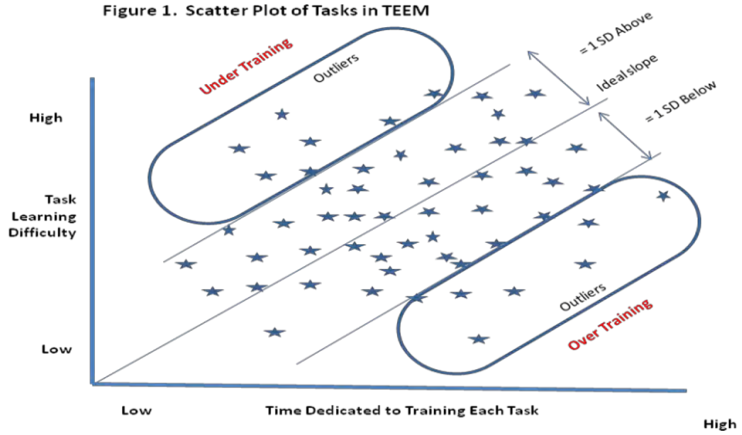
performed together. This technique creates groups of tasks that often share key features of common tacit and explicit knowledge, common tools, and common processes. It is not perfect, and requires analyst judgment to determine when task modules should be separated and when they should be joined, but in general, it reduces the numbers of items in the TIDES analysis to a manageable level, and enables Subject Matter Experts (SME) providing other data (the LCs, the TT, TRR and TRA data in particular) to make better estimates of time and resources required to achieve proficiency through training. Once the TMs are created using co-performance, it is a fairly easy step to cross-compare the task modules with the jobs, by cohort group, to see which TMs make up which jobs, and whether proficiency/competency gained in early jobs should transfer to more senior jobs as the individuals progress from entry through career stages. Creation of TMs using co-performance is a fairly easy routine to run, but doesn't have immediate bearing on AFOMS' primary customer, so it has been discontinued. An alternate approach to creating TMs involves using SME panels to achieve similar grouping. While there is merit to this in terms of expediency, it opens the subsequent analysis to suspicion of bias, especially if the SMEs have insufficient breadth of knowledge of and experience with the AFS. And the foundation of the TIDES analysis rests on the ability of other SMEs to use the task modules to recognize jobs, estimate proportions of resources dedicated to training for them (TT, TRR and TRA), and to estimate both formal and on-the-job training required to achieve proficiency (LCs).

Obviously, a clear Job Structure is essential to constructing a relevant J&TH survey. If a particular OAR is conducted without a reasonably reliable job structure analysis, it may be necessary for HRDD to supplement the original OAR before a J&TH survey and other data collection instruments can be constructed.

Training Efficiency and Effectiveness Methodology (TEEM) Requirements:

The TEEM is a computer-based method for integrating data from occupational analysis, field unit inputs and course documents to identify trends of under- and over-trained tasks for the purpose of improving formal course content (Metrica, 2000; Teachout, Sego & Ford, 1995; Teachout, Sego, & Olea, 1993). The conceptual foundation of TEEM is that in technical training, tasks with high Task Learning Difficulty (TLD) should receive greater emphasis in formal training than those with lower ratings. TEEM generates a Cartesian graph (quadrant I, only) reflecting the relative position of tasks trained in formal courses (see Figure 1, below). Along the X-axis, tasks are rated in terms of time dedicated to training the task in the course. The Y-axis reflects the degree of task learning difficulty the task received in AFOMS' OAR. The resultant scatter plot can be analyzed, focusing on those tasks outside a reasonable boundary of, say, one standard deviation from the regression line, and judge whether the excessive time is spent on tasks relative to their TLD or whether time balance is disproportionately low.

Figure 1. Scatter Plot of Tasks in TEEM



Using TEEM, Training Developers and Training Managers can zero in on those tasks which appear to have the greatest disparity between degree of difficulty and amounts of time dedicated in formal courses. The result of such analyses yields opportunities to further refine and improve the efficiency and effectiveness of the Air Force's training investment in each specialty where it is employed.

Simulation Utility Analysis System (SUMS):

SUMS was developed to create an entity-based personnel flow model to analyze a multi-job system linking job performance and enlistment standards (Stone, Turner, Engquist, & Looper, 1993; Stone, Turner, Fast, Curry, Looper, & Engquist, 1992). It provides capability to affect such human capital management factors as enlistment standards, job classification standards, promotion policies, and force-restructuring initiatives. The SUMS provides managers with the capability to analyze aptitude standards as they affect force structures, experience mixes, and force productivity at the career field level and various other levels of aggregation. In addition, the system can evaluate alternative aptitude and experience mixes within and across AFSs.

SUMS operates at a higher level of abstraction than do TIDES or TEEM, however, it creates models similar to TIDES in terms of establishing a baseline of aptitude indicator data and several other human capital policies, such as desired retention rates, personnel flow through various stages of a career, and attrition rates as cohorts reach career milestones. As such, it provides potential to supplement or complement projects using other tools. That potential is enhanced when there are consistent practices in data gathering from one study to the next.

Acquisition Information Retrieval and Simulation (ACQUIRES) System:

The ACQUIRES system is a tool developed specifically to model human capital management practices for the Air Force Systems Command Acquisition Professional Development Program (APDP). ACQUIRES simulates the civilian force at the individual entity level and provides extensive database facilities for analyzing and summarizing this individual level data. ACQUIRES allows for the analysis of the effects of APDP policies on the flow and content of the civilian acquisition force within the context of a simulation and projection model. Policymakers could analyze short-term and long-term implications of changes in professional education requirements on the civilian force and the future course needs to meet these changes. It bears passing resemblance to TIDES in that it models the flow of a particular population through a regimen of highly structured training and experience events in order to impose discipline on a very sensitive Air Force issue, the handling of research and acquisition funds.

As a template, ACQUIRES could be modified to address other sensitive Air Force issues (e.g., the career management of those charged with controlling nuclear weapons materials, or defining development patterns of highly sensitive and visible human capital assets such as training of pilots or UAV operators). In such cases, availability of AFOMS data to form a foundation for timely, high-fidelity simulation of personnel and manpower policies and practices would be invaluable. Key data from AFOMS would involve job structures of the occupations, differences in work performed by progressively more experienced cohorts, identification of key competencies (as revealed by Task Modules), task factor data that may mitigate or validate task performance data with respect to given policies and background information on previously held jobs, capacity of courses to support volumes of trainees, and histories of progressive assignments building on prior experience.

Statistical Neural Network Application Package (SNNAP):

Statistical Neural Network Application Package (SNNAP) was developed to be able to analyze artificial neural network models of decisions, time-series phenomenon, system control, and other input-output relationships (Wiggins, Grobman, and Looper, 1993; Wiggins and Looper, 1993). SNNAP implements three network architectures (back propagation, probabilistic neural networks, and learning vector quantization) and utilizes special training heuristics to improve out-of-sample performance. The package was developed to optimize performance on highly stochastic databases with potentially nonlinear and interacting features. SNNAP can be used in a number of decision-support systems, and while AFOMS data are not directly needed by SNNAP, those data can be used in many modeling and simulation concepts where SNNAP is an integral feature.

Job Structuring Technology (JST) Requirements:

JST was developed as a way of providing a timely decision aid to assist Air Force stakeholders in evaluating alternative scenarios for achieving a large body of work over a career life cycle (20 to 30 years) (Weissmuller, Driskill, Mitchell and Gosc, 1996). JST establishes scenarios, and exemplar entities representing airmen in the AFS are "run" through the model on monthly intervals, where exemplars are promoted and reassigned. Each exemplar carries a Proficiency Folder (PF) which records module-level experience & proficiency for every module being simulated. This PF is automatically updated to reflect increased proficiency when the exemplar attends a course or performs on-the-job. When an exemplar is assigned to a job, the proficiency scores from the PF are matched against specified Job Requirements (JR) and the importance of those requirements to the mission. The weighted percentage of job incumbents exceeding and failing minimum standards are reported for each month as a goodness-of-fit which can be reported for the full force, within a specified AFS, or for a given task module in the master folder. Running a JST model gives stakeholders a chance to evaluate the effects of modifying variables representing human capital management policies.

The key data needed for JST operation that could originate from AFOMS data includes:

1. Task & Duty List (from USAF Job Inventory)
2. Percent Members Performing (PMP) for selected groups:
   - Full Group (Everyone in the AFSC)
   - 1-24 Months Total Active Federal Military Service (TAFMS) (School/First Assignment)
   - 25-48 Months TAFMS (Productive Half 1st Term)
   - 49-96 Months TAFMS (Second Term)
   - 7 Skill Levels (High Tech/Management)
3. TD - Task Learning Difficulty: relative, within AFSC
4. BLD-IT – Benchmarked Learning Difficulty – Individual Task level
5. Task Co-Performance Modules
6. Task Co-Performance Clustering Solution (CLUSEXT)
7. STS, POI, CTS, CEC documents with mappings into the task list
8. Enhanced Task Modules (to include Equipment, Knowledge, etc.)

Phase III. In analyzing the gap between current AFOMS/OA outputs and those requirements of the HRRD tools, many of the needed data elements are available; however, some data types have been discontinued or modified. Four important gaps were noted in developing this plan; limited availability of job structure information in some, but not all, OARs, an absence of co-performance task modules, limited information on degree of inter-rater reliability on task factor data, and uncertainty about being able to reconstruct data in the event additional analyses are required to be able to support AF/A1PF in responding to Air Force stakeholders regarding such issues as rationally restructuring the force, adjusting recruiting standards and accession goals, or modeling potential new occupations.

The absence of thorough job structure analyses, based on hierarchical clustering of cases using the Ward Method (Levine, 2003) in every OAR raises the specter that if TIDES or TEEM or JST analyses should be desired, the HRRD may be faced with the option of accepting the less-reliable approach of using a structure solution based on incumbent-selected job titles or on performing an expensive follow-up job structure analysis using the traditional hierarchical clustering method. Running such a follow-up analysis would be predicated on being able to reassemble the records in a suitable format (probable, but not guaranteed) from the current ORACLE output format.

The absence of task co-performance clustering could place an additional burden on any TIDES analysis or JST analysis. That burden is similar to the one created by an absence of case clustering; the ORACLE output require reformatting for tools that can run the task clustering solution using Ward's Method.

From the period of their earliest conceptions, task factor data were routinely collected on all tasks within a given OA project. In an effort to be responsive to AFOMS' primary customers, the first enlistment training establishment of Air Education and Training Command, the strategy for collecting Task Learning Difficulty in most surveys has been restricted primarily to technical tasks, omitting the supervisory, planning and evaluating, and some administrative tasks. The TEEM tool is somewhat impacted by the reduced Task Learning Difficulty data collection; however, the impact is not insurmountable, and may even be negligible, since the TEEM focus is on those tasks associated with technical aspects of the job.

The HRRD may need the capacity to conduct BOLD technique to estimate the relative TLD across AFSs to supporting such analyses as researching appropriate cut scores for different Air Force occupations on the Armed Forces Vocational Aptitude Battery. Current AFOMS TLD data provide valuable source material for such BOLD studies, but there are still a few unanswered questions about AFOMS task factor data. As mentioned earlier, while TE and TLD values were present in the samples shown to this author, the information about their inter-rater reliability was not evident.

It may also be useful for AFPC/DPSF to be able to resurvey occupations if supplemental data are needed to fill gaps in the information provided by AFOMS' primary surveys.

CONCLUSIONS

The Transition Plan for moving AFOMS data to the HRRD is still in flux due to ongoing reorganization efforts. While a decision was reached in early May by the AFOMS Commander to "give all the data" to HRRD at the conclusion of each OAR, questions remain as to what data will be sent and whether it will be interpretable without substantial reverse engineering. The effort to perform this contract did uncover some positive information regarding Occupational Analysis in the Air Force. While there have been discussions of major changes to the methodology, the core of OA is still present in the work of AFOMS. The concerns uncovered in this effort; however, should not be overlooked. First, the Air Force should have some assurance that current methods are as good as, or superior to legacy methods. To that end, AFPC/DPSF should seek to obtain published demonstrations of the equivalence of current methods to traditional methods. In the absence of those demonstrations, the HRRD should consider conducting benchmarking studies on a small but representative sample of completed OARs, to determine the degree of confidence that can be placed in the AFOMS-published job structures. In the absence of published head-to-head comparisons, it seems reasonable that AFOMS would at least tell AFPC/DPSF which SPSS clustering solutions are being used.

Related to that matter is the issue of being able to follow-up on OAR projects with additional analyses. A willingness of AFOMS to pass on copies of the raw data, prior to input into ORACLE, would give assurances that the original records can be reconstructed for additional analyses. In the absence of the original raw data records, it is imperative that HRRD receive not just the large volumes of relational data, but the task list and other elements of the survey instrument, (e.g., background questions, equipment lists, and special analysis questions).

As a general practice, HRRD should avoid wherever possible the use of SME panels in lieu of researched and documented quantitative methods for determining job structure and task module solutions. In some cases, that may be necessary, but whenever possible, if the job structure isn't present, and in all cases where co-performance task clustering hasn't been done, consideration should be given to making those steps part of any analysis plan when employing the research tools mentioned above. Having the ability to resurvey occupations following AFOMS' OAR publications would enable AFPC/DPSF to address some data shortfalls.

With regard to task factor data, it would be useful to know the inter-rater reliabilities of the data sets AFOMS publishes in their OARs, even if AFOMS doesn't want to put them in their published reports. Each occupation is unique, and each occupation's task factor data may be more or less reliable. Use of unreliable data could lead to a false confidence by users who don't understand the limitations of the data, and whose subsequent decisions may be based on unsound information.

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